U. S. DEPARTMENT OF AGRICULTURE

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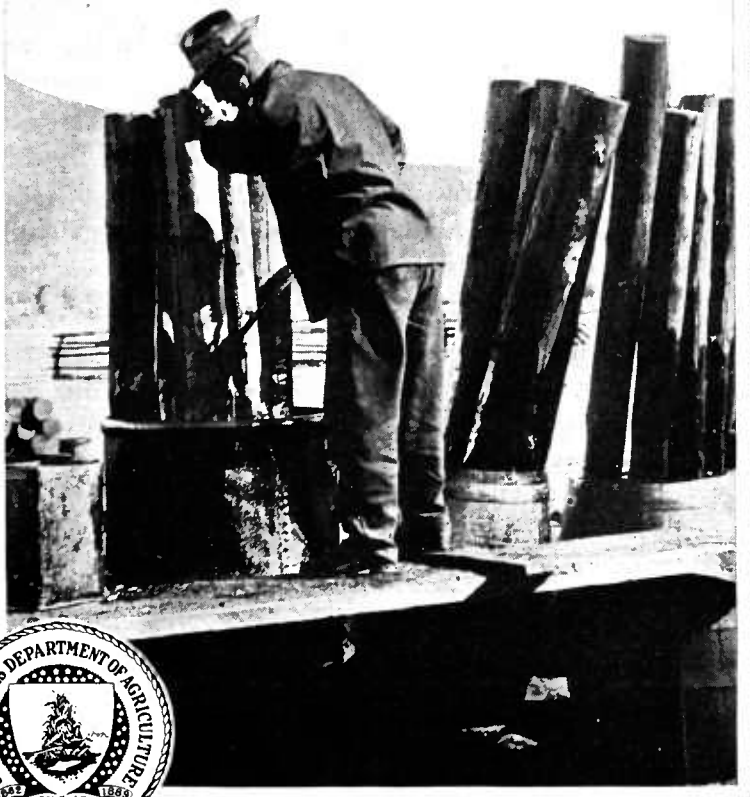
The PRESERVATIVE TREATMENT of FARM TIMBERS



WOOD DECAYS when in contact with the soil or in other damp places. The heartwood of some species of wood is decay-resistant and gives good service without treatment. The sapwood of all species and the heartwood of many rot quickly, under conditions which favor decay, unless protected by treatment with an effective preservative.

Where highly durable woods are still plentiful and cheap, preservative treatment may not be economical. Generally, however, the proper use of preservatives will save money by greatly increasing the life of the wood. Preservatives also make possible the successful use of home-grown posts of practically all species of wood even though they may have very short life if used untreated.

This bulletin is of value to all who are interested in prolonging the life of building timbers, poles, and posts, especially on farms at a distance from wood-preserving plants.

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THE PRESERVATIVE TREATMENT OF FARM TIMBERS

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INTRODUCTION

THE QUANTITY of wood used on the farms of the country and exposed to decay is very great. The total is difficult to estimate, but it undoubtedly amounts to several billion board feet annually. This wood is used in various forms, such as fence posts, building foundations, windmill frames, shingles, telephone poles, silos, vine stakes, and small buildings. For such uses durability is usually of great importance.

Some woods resist decay better than others. A post of one kind of wood may last 10 years, or more, while one of another kind may last only two years under the same conditions. There is also a great difference in the durability of wood of the same species under different conditions. In a very wet or a very dry situation a post will last longer than in a situation where the ground is simply damp or alternately wet and dry. It will last better in a compact clayey soil than in a loose sandy soil. A warm, moist climate is more favorable to decay than a dry one, or one that has long, cold winters.

Durable woods are continually growing scarcer and higher priced in most localities, and less durable woods must be used in their stead. Many of the nondurable woods in their natural condition will last only two or three years in situations favorable to decay. It will readily be seen, therefore, that any reasonably cheap method of increasing their life will save money for the user.

For a number of years the Forest Service has been conducting experiments on the preservative treatment of fence posts, poles, and other forms of timber exposed to decay. These experiments have

been made in cooperation with agricultural experiment stations, farmers, and various companies, and also upon the national forests. They have proved conclusively that when a suitable preservative treatment is given, posts or poles that would ordinarily rot quickly can be made to last 15 to 30 years and that similar resistance to decay can be obtained with other forms of timber.

DECAY

Decay is not due to the chemical action of the soil or to the fermentation of the sap, but is the result of the action of certain low forms of plant life called fungi. These consist, for the most part, of very fine threadlike filaments, which penetrate the wood in all directions. Certain substances in the wood constitute the food of the fungi. As these substances are dissolved the wood structure is broken down, until it becomes rotten.

The fungi usually grow out to the surface to form compact masses called fruiting bodies. Since there are many kinds of fungi, there are many kinds of fruiting bodies. The various forms of "toadstools," "punks," "brackets," or "dog ears," which are so frequently found growing on trees and deadwood, are examples of fruiting bodies. (Figs. 1 to 4.) Their presence generally means that decay has made considerable progress in the wood. All fruiting bodies produce spores, which are to the fungus what seeds are to higher plants. Millions of spores may be produced by a single fruiting body, and they are so small that they are able to float long distances in the air. When a spore drops upon a piece of wood and conditions are favorable, it germinates and the fungus begins its destructive action.

Another way in which decay spreads is by the fungus growing from one piece of wood to another. When a piece of decaying wood is in contact with a sound untreated piece the latter may rapidly become infected in this way and be ruined.

The four requirements for the growth of fungi are moisture, air, a favorable temperature, and food.

A damp condition of the wood is the most favorable to decay. Wood can be either so wet or so dry that the fungi can not live in it. When submerged in water wood has been known to last hundreds of years, and in perfectly dry situations it will last indefinitely. Wood in contact with damp ground usually contains the right amount of moisture for the development of decay. Also, where timber is in contact with wood or other material, water frequently collects in the joints and keeps the wood moist for long periods of time, thus favoring decay at these points. Familiar examples of this are decay in the tops of posts in board fences (fig. 5), in the joints of various kinds of buildings (fig. 6), in porch columns, in sills resting on wood or stone piers, and in lumber piles.

There are very few places where the fungus can not get air enough for its needs. When wood is buried deep in the ground, especially in compact or clayey soil, it tends to become saturated with moisture, so that decay is prevented; but within 2 or 3 feet of the surface of the ground there is usually enough air for the growth of the fungus. Conditions are most favorable, of course, just at the surface of the

ground; and it will be noted that the point of greatest decay in a fence post is usually near the ground line. Above the ground line moisture conditions are usually unfavorable, and below the ground line the air supply is less favorable for the rapid development of decay. In loose or sandy soils, however, which under good drainage contain more air than compact soils, decay may extend to the bottom of the post.

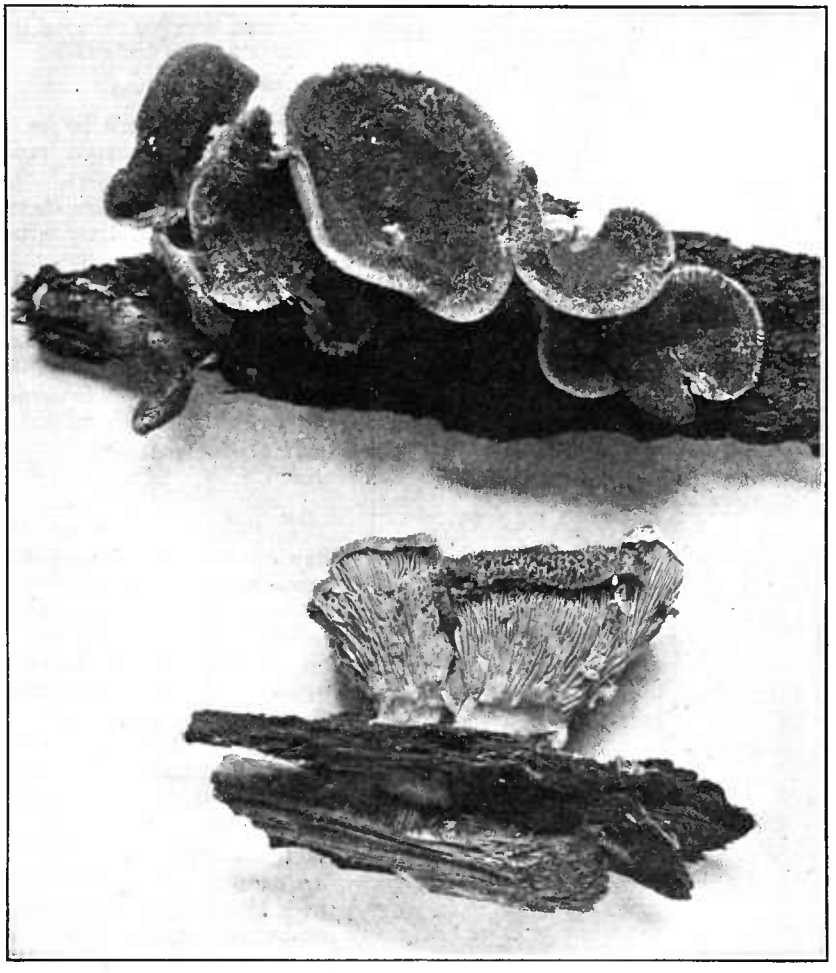

FIG. 1.—Fruiting body of fungus, *Lentinus lecomtei*

Wood-destroying fungi can not grow at very high or very low temperatures; but there are few, if any, climates in which the temperature during at least part of the year is not favorable to their growth.

The wood itself supplies the fourth requirement of the fungi, which is food. In order to prevent decay, it is necessary to deprive the fungus of one or more of these four requirements. It is out of the

question in ordinary situations to deprive it of air and warmth; and though moisture can sometimes be eliminated to a certain extent, this can not be done when the wood is exposed to the weather. In general, therefore, the most effective method of preventing decay is to poison the food supply; and upon this principle is based the use of most successful wood preservatives.

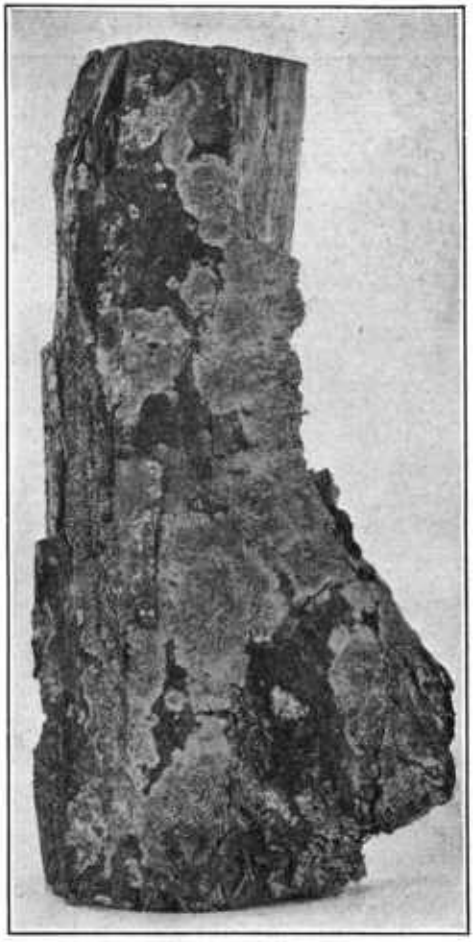

FIG. 2.—Fruiting body of fungus, *Poria* sp.

PROLONGING THE LIFE OF POSTS WITHOUT THE USE OF PRESERVATIVES

PEELING

Posts which are to be set without preservative treatment should be peeled.[1] The bark allows moisture to collect, and thus makes conditions favorable to decay. It also harbors wood-boring insects, which, by boring tunnels, may both seriously weaken the post and make conditions more favorable for rapid decay by affording easy access to fungi.

SEASONING

The general impression has been that seasoning wood makes it more durable. In a number of experiments made by the Forest Service on poles and ties, however, green wood has been found as durable as seasoned wood. It is believed, therefore, that it does not pay to season posts simply to increase their durability.[2] Wood in contact with the soil will take up or give off moisture and in a short time will reach a moisture content determined by the amount of moisture in the soil. It therefore makes little difference whether such wood is originally dry or green.

Posts must not be held so long that decay begins before they are set. The instructions for seasoning given on pages 13 to 15 should be followed. Posts should never be left close piled for any length of time.

[1] Gambel oak, which is used untreated for posts in parts of the southern Rocky Mountain region, appears to be an exception to this rule, as it is said to last longer if the bark is left on.

[2] Lumber for buildings should be thoroughly seasoned before use, however, as green lumber will cause trouble by shrinking as it dries, and, in confined spaces, it may dry so slowly that it will decay before it seasons.

CHARRING

In some cases charring has appeared to give good results; in others, however, it has failed to give any appreciable protection, and it can not be relied upon.

STONES

Piling stones around the base of the post has sometimes been resorted to. This tends to keep back the weeds and allow the air

FIG. 3.—Fruiting body of fungus, *Polyporus betulinus*

to circulate freely around the post. However, where the ground is wet during a considerable portion of the year the use of stones in this way may favor decay rather than retard it, because the post is allowed to dry out partially between wet spells. It would be better to keep it constantly wet.

In dry sandy regions posts are sometimes very badly cut by drifting sand being blown against the wood. This effect is sometimes called "burning." Piling stones around such posts would, no doubt,

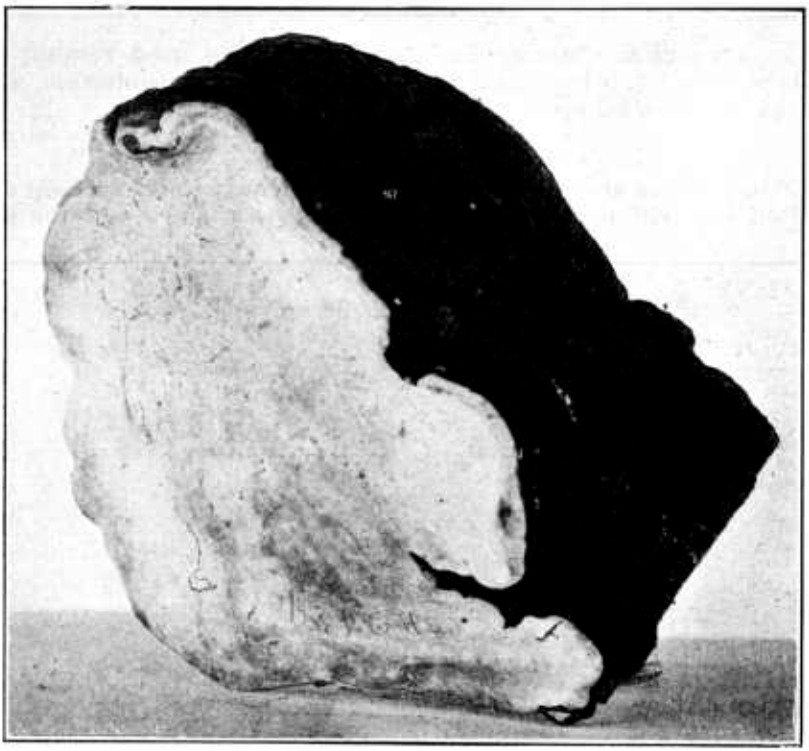

FIG. 4.—Fruiting body of fungus, *Fomes pinicola*

be effective in preventing the sand cutting. It is doubtful, however, if results obtained by the use of stones for the sole purpose of preventing decay will justify the labor involved.

SETTING IN CONCRETE

Setting posts in concrete may sometimes prevent decay, but it can not be depended upon. If the concrete keeps the wood dry it will retard decay, but if water gets into the wood, through some defect in the concrete or in the wood, the concrete may retard the water drying out again and thus hasten decay. This is an expensive method of setting posts and is not recommended for preventing decay.

PROLONGING THE LIFE OF POSTS BY MEANS OF PRESERVATIVES

REQUIREMENTS OF PRESERVATIVES

There are six important requirements for a preservative for general use. It should be safe to use, should be reasonably cheap, should penetrate wood readily, should not be corrosive to metal,

should not evaporate or wash out of the wood easily, and should be poisonous to fungi. For special purposes there are, of course, additional requirements.

VALUE OF VARIOUS PRESERVATIVES

COAL-TAR CREOSOTE

Coal-tar creosote, which is a brownish-black heavy oil, practically insoluble in water, is in general use for preserving fence posts and other farm timber. Satisfactory penetration of many species of wood can be secured with it, and excellent results have been obtained by its use. It is considered about the most effective preservative against decay so far developed for farm timbers exposed to the weather. It may also be used for inside work wherever its color, odor, and other properties are not objectionable.

Coal-tar creosotes vary considerably in quality; but satisfactory results may be obtained from any good grade, provided a sufficient amount is put into the wood and a good penetration is secured. Creosotes containing a high percentage of oils which boil at a low temperature are not so suitable for use on the farm as those which contain a lower percentage of these oils, because a considerable portion may evaporate

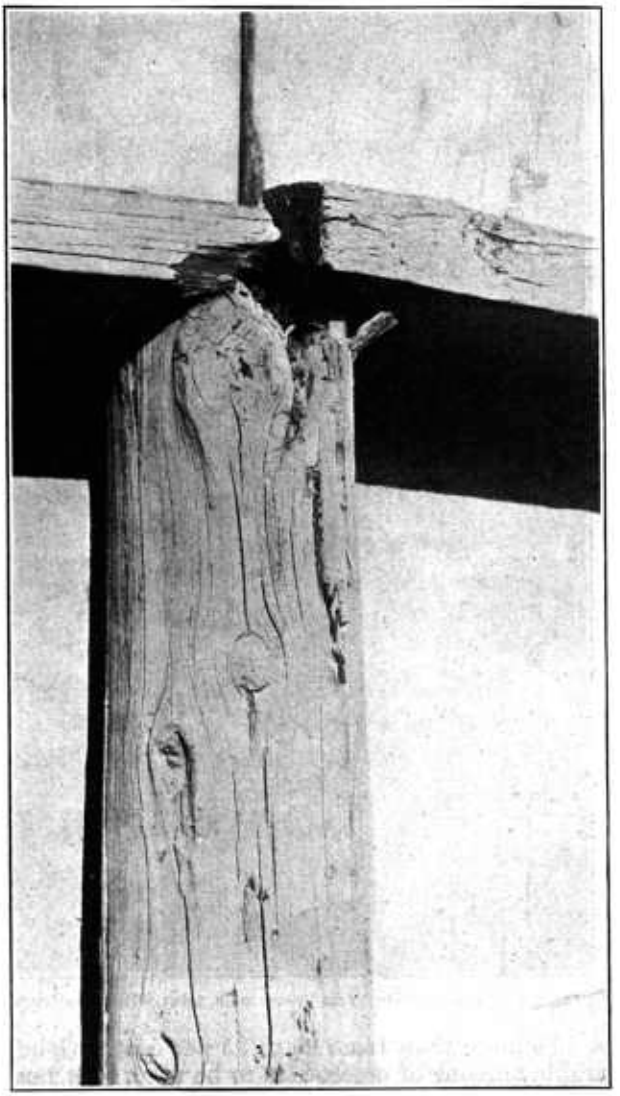

FIG. 5.—Decay in top of fence post and adjacent stringers due to collection of moisture

during treatment. In some cases as much as one-fifth of the oil used has been lost in this way. This loss of oil by evaporation may be largely offset, however, by the lower price at which the low-boiling creosotes may usually be obtained. The increase in price which can be economically paid for the higher boiling creosotes will in general

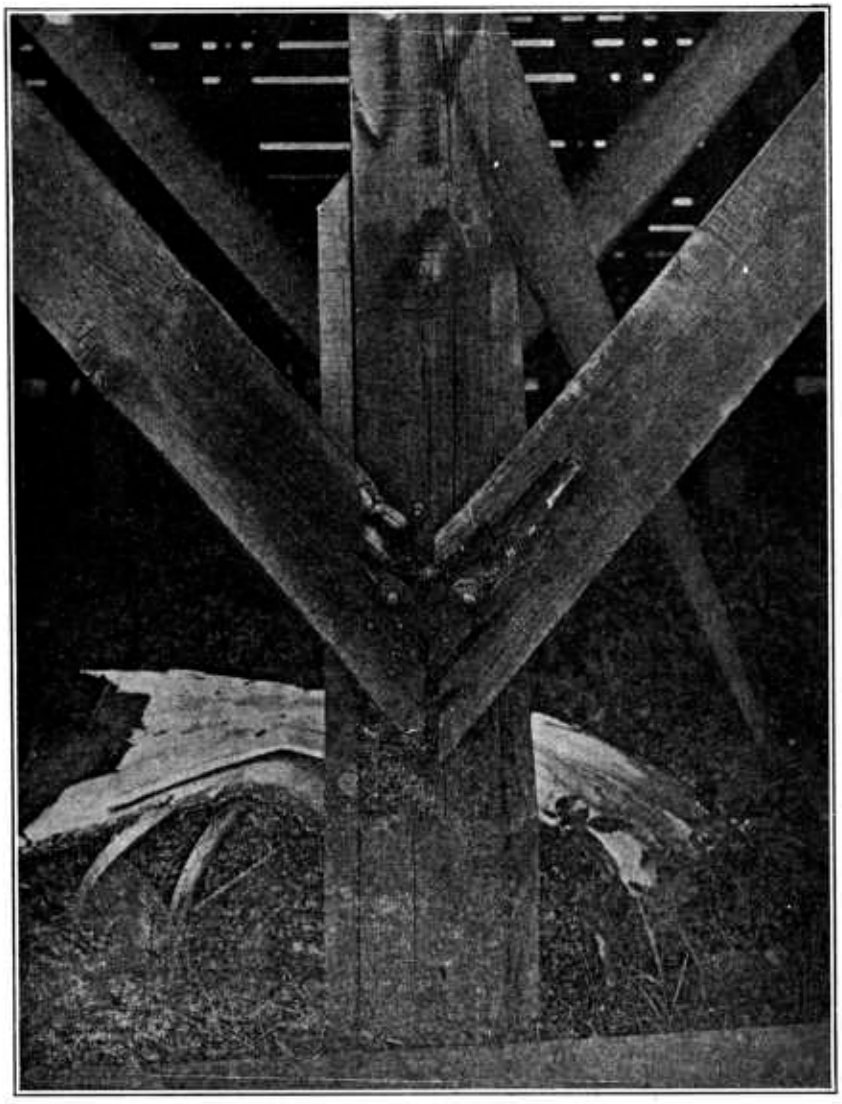

FIG. 6.—Decay in braces at a joint where moisture has collected

not be more than from 25 to 35 per cent. Generally, when a considerable amount of creosote is to be used, it is purchased under specifications. If required, further information on this point, as well as lists of manufacturers and dealers, can be obtained from the Forest Products Laboratory, Madison, Wis.

CARBOLINEUMS

Carbolineums are proprietary preservatives similar in appearance and preservative qualities to coal-tar creosote, but usually higher in price. They are higher boiling than ordinary coal-tar creosotes and therefore do not evaporate quite as rapidly when heated. In service tests made by the Forest Service on brush-treated telephone poles, carbolineums have given about the same increase in durability as coal-tar creosote.

WOOD-TAR CREOSOTES

But little reliable data upon the effectiveness of wood-tar creosotes are available, and until satisfactory service tests are completed no definite recommendation can be made. The data thus far available, however, indicate that good results will be obtained if the wood creosote is of a high grade.

WATER-GAS-TAR CREOSOTE

Water-gas-tar creosote is an oil similar in many ways to coal-tar creosote, but its value as a fence-post preservative has not been fully established. It is not considered the equal of coal-tar creosote, but will probably give very good results if the wood is well treated with it.

TAR

Tar is not a good preservative for farm use; and, in general, good results have not been obtained with it when applied by methods that are practicable on the farm. The chief objection to the use of tar is that it does not penetrate the wood readily. Coal tar and water-gas tar are also much less poisonous to the organisms which cause decay than is coal-tar creosote.

PETROLEUM OILS

Petroleum oils, as a rule, are not poisonous enough to wood-destroying fungi to protect wood from decay. The use of crude petroleum, fuel oil, lubricating oil, and similar petroleum products is not recommended, therefore, unless they are mixed with at least 50 per cent of coal-tar creosote.

CREOSOTE MIXTURES

Coal-tar creosote is so destructive to fungi that it can be diluted with less effective oils and still give very satisfactory results. It is better to use straight creosote, but where the cost of creosote is almost prohibitive economy may result from using it mixed half and half with a suitable, cheaper oil. Water-gas tar, water-gas-tar creosote, and gas oil are suitable, provided they are clean and of good quality. Coal tar, fuel oil, and crude petroleum are likely to reduce the penetrating properties of the creosote and should be avoided if more suitable oils are available. They can be used successfully, however, with woods which are easy to penetrate, provided sufficient care is taken during treatment to insure deep penetration. Spent crank-case oil

can probably be used successfully for mixing with creosote, but no experimental evidence concerning its use is available.

In mixing oil with creosote it is best after stirring the oils together very thoroughly to allow the mixture to settle and then to use only the liquid portion. Any sludge which separates out should be discarded.

ZINC CHLORIDE

Zinc-chloride solution gives good results when properly applied and used under the right conditions. Zinc chloride is sold in solid form or in a 50 or 70 per cent solution, and is injected into the wood in a solution of from 2 to 5 per cent in water. The 50 per cent solution is the most convenient form to use on the farm or in small plants. Zinc chloride is much cheaper than coal-tar creosote. On account of its solubility in water it is washed out of wood in time by the rain or ground water, which is the chief objection to its use, but this effect is usually so slow that it does not prevent the treated wood from giving very good service.

In general, zinc chloride is not considered as satisfactory for farm timbers as coal-tar creosote, but there may be places where its use is advisable. For wood to be used indoors zinc chloride may be satisfactory where creosote would be objectionable on account of its strong odor, dark color, and because it can not be painted satisfactorily. Zinc chloride is not recommended, however, for use by the brush or painting method.

SODIUM FLUORIDE

Sodium fluoride is a white powder which, dissolved in water to make a 2 to 4 per cent solution, is very effective in preventing decay. It is more expensive than zinc chloride but has somewhat similar properties and value as a wood preservative. Sodium fluoride is moderately poisonous and should therefore be handled with care.

MERCURIC CHLORIDE

Mercuric chloride (corrosive sublimate) is a white powder which makes a very effective wood preservative when dissolved in water. It has been successfully used in wood-preserving plants, especially in Europe, for many years. Because it is a deadly poison and is also corrosive to iron and steel, mercuric chloride can not be recommended for general use.

PAINT, LINSEED OIL, WHITEWASH

Good results in preventing decay can not, in general, be expected from paint, linseed oil, whitewash, or similar materials when used on fence posts or other timbers in contact with the ground. They do not penetrate the wood deeply, and as a rule are not poisonous to wood-destroying fungi. It is sometimes believed that they can prevent decay by preventing the entrance of fungi or moisture into the wood, but this belief is not well founded. Wood is seldom painted on all sides, so it is usually possible for fungus to enter through an unpainted part. Furthermore, whenever the painted film cracks or peels off, fungus can enter. Experiments have shown, also, that

paint films do not prevent moisture changes, but merely retard them. It is quite common to see wood decaying beneath a coat of paint. (Figs. 5 and 7.)

FIG. 7.—Painted post decayed at the ground line

CEMENT COATINGS

Posts have sometimes been dipped in thin cement and allowed to dry, leaving a coat of cement over the surface of the wood. Such

a coating will not keep out water and is easily cracked or broken off. Good results in preventing decay can not be expected from this treatment. Experience with mine timbers has shown that even thick coatings of cement applied with a powerful air spray do not prevent decay.

PATENTED OR PROPRIETARY PRESERVATIVES

Patented preservatives, or those sold under trade names bearing labels which do not disclose the composition of the preservative, are sometimes of good and sometimes of doubtful value. Excessive claims are often made for their effectiveness even when applied by very superficial methods and they are often sold at unnecessarily high prices. It is best for the average farmer, therefore, before purchasing a patented preservative to secure advice from his local county

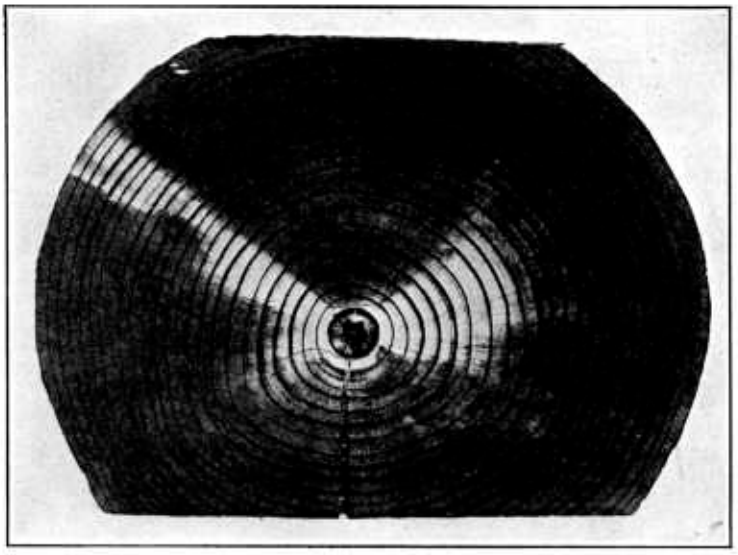

FIG. 8.—Treated pine tie. The light streak shows where penetration has been retarded by a strip of bark

agent, agricultural experiment station, or other State authority, or from the United States Forest Products Laboratory.

PREPARING POSTS FOR TREATMENT

Only sound posts are fit for treatment. If decay has made a start it is not always entirely stopped by the treatment, but may continue beneath the treated wood until the interior of the post is destroyed. The first thing to consider, then, is the selection of sound wood.

PEELING

All timber should be peeled before the preservative is applied. In peeling posts of pine, cedar, and other coniferous woods care should be taken to remove the thin inner bark from the part of the post that is to be treated. Even small patches of this bark often prevent penetration by the preservative. (Fig. 8.) When the bark

drops off, a patch of untreated or poorly treated wood is exposed, and the opportunity is offered for decay to enter. The effectiveness of the treatment depends on maintaining an unbroken area of treated wood entirely around the post. In some of the hard woods strips of bark do not retard penetration so seriously, but it is safest to peel all posts regardless of species.

BEVELING TOPS

Beveling the tops of posts to a sharp edge, so that snow and water can readily drain off, is held by some to increase the durability of the tops. Theoretically this is a good practice, but there seems to be little definite proof that it results in an appreciable increase in durability.

SEASONING

In order to obtain the best absorption and penetration of preservative the posts must be seasoned before treatment. The water must come out of the wood to make room for the preservative to go in. Furthermore, wood treated green is likely to check open after treatment, exposing untreated wood. Seasoned wood which has been wet by recent rains is not in good condition to treat.

The best place for rapid seasoning is an exposed location on high, well-drained ground. On damp or low ground or near a stream seasoning will take place much more slowly, and the wood will never get quite so dry. If properly piled in a good location, posts will usually season sufficiently for treatment in from 60 to 90 days of good seasoning weather. In exceptional cases they have been known to season in a month.

It is sometimes difficult to determine from its appearance whether timber is sufficiently seasoned or not. By weighing a few representative posts at regular intervals it is possible to determine the degree of seasoning very closely. When an ordinary sized post properly piled for seasoning does not lose more than a pound or two in weight during a week of dry weather it may be considered dry enough to treat.

PILING

The posts should be open piled, so that the air will circulate freely around each one. The bottom of the pile should be raised at least a foot from the ground. Figure 9 illustrates a good method of piling. Another method, but somewhat less desirable because one end of each post is on the ground, is illustrated in Figures 10 and 11. If the ground is dry, the posts can be seasoned where they are cut by laying them upon rocks or brush, or keeping them off the ground in any other way. Posts should never be piled in close piles or allowed to lie on the ground; for under such conditions they will frequently start to decay before they are seasoned. (Fig. 12.)

CHECKING

Some woods, such as oak and chestnut, check very badly when dried too rapidly. It is well, if possible, to cut and peel such

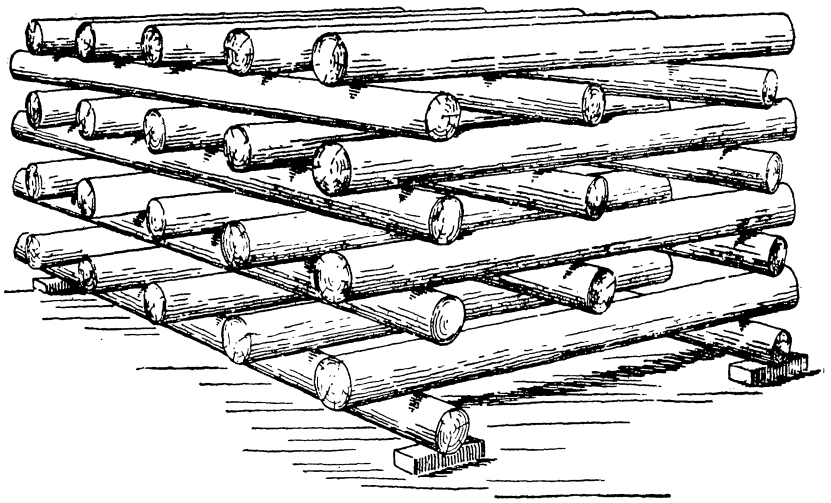

FIG. 9.—A good way to season posts.

timber in the fall or winter, so that by the time warm weather comes it will be partially seasoned. The pines, firs, and other coniferous woods are usually not affected so seriously as the oaks by rapid seasoning. In seasoning woods which are likely to check severely it will be helpful to make the seasoning piles in partial shade and to paint the end surfaces of the posts.

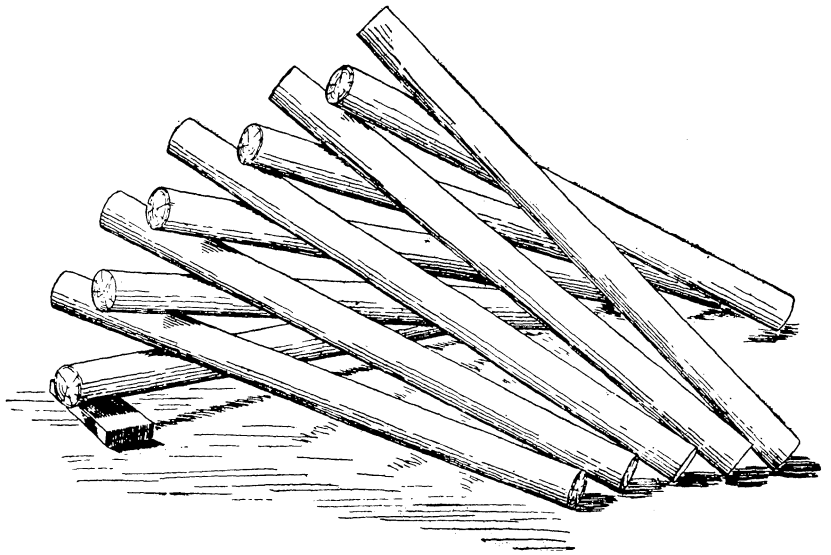

FIG. 10.—Another method of piling posts to season. Not so satisfactory as that shown in Figure 9

TIME OF CUTTING

The time of year when posts are cut is not of great importance if they are properly cared for after cutting. The bark peels best in the spring and early summer, which is an advantage, but seasoning in the summer is likely to be so rapid that it may result in

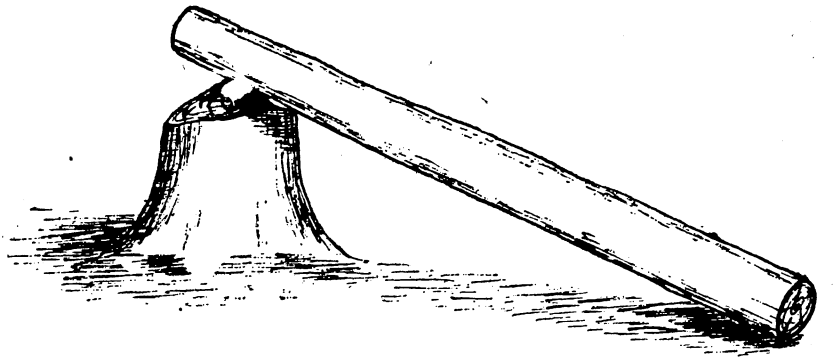

FIG. 11.—Seasoning against a stump

severe checking. In warm weather, wood improperly piled may very quickly start to rot. Timber cut in the late fall or winter, seasons more slowly, as a rule, and with less checking than during the warmer months. Fungi and insects do not attack wood out of

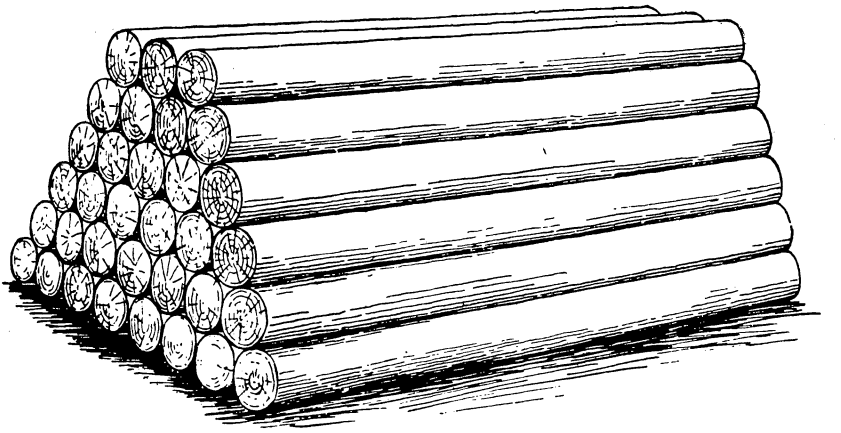

FIG. 12.—A close pile. A poor way to pile posts for seasoning

doors in cold weather, and by the time warm weather begins the wood, if peeled, usually has dried sufficiently to withstand their attack.

METHODS OF APPLYING PRESERVATIVES

The methods of applying preservatives to wood differ considerably in character, cost, and effectiveness.

PRESSURE PROCESSES

Impregnation under pressure is the most satisfactory means of injecting preservatives into wood. The various pressure processes differ in details, but the general principle is the same in all. The wood is placed in steel cars and run into a long steel cylinder. This is closed and the preservative is pumped in. Pressure is then applied until the desired quantity of preservative has been absorbed by the wood. There are about 135 wood-preserving plants in the United States using pressure processes, and millions of gallons of coal-tar creosote, zinc-chloride solution, and mixtures of the two are used each year. It would be well for anyone living within reach of such a plant to consider having his timber treated there, if satisfactory arrangements can be made; for a good pressure treatment will usually be more effective than any treatment that can be made on the farm.

It is now possible in many localities to purchase pressure-creosoted posts at retail lumber yards. As a rule these posts are well treated and will give very satisfactory service. The practicability of using them should be considered before deciding to make treatments at home.

THE HOT AND COLD BATH PROCESS FOR OILS

The hot and cold bath open-tank process is the most thorough method of treatment that is practicable on the farm. The posts are heated for one or more hours in the preservative (usually coal-tar creosote) at a temperature of from 180° to 220° F. They are then quickly transferred to a tank of preservative having a temperature of about 100°, and are left there for one hour or more. In the hot bath the air and moisture in the wood expand and are partially driven out. When the wood is plunged into the cool oil the air and moisture in the wood contract and draw in the oil. Except for a few very easily treated woods, there is little absorption of oil by the wood during the hot bath. Instead of a separate tank being used for the cool bath, the heating of the oil in the hot bath may be stopped and the wood and the oil allowed to cool together. This accomplishes the same purpose as the cool bath; but a longer time is required because the hot oil cools very slowly. The single-tank treatment is particularly suitable for heavy posts or poles which can not be easily transferred from one tank to the other. It can sometimes be used to advantage also by heating for two or three hours early in the morning or in the evening and allowing the posts to cool all day or all night. This will make it possible to carry on the treatment without interference with the regular work of the farm. The posts may be treated more rapidly, however, by using the two tanks.

It is desirable in the hot and cold bath treatment to have the sapwood penetrated all the way through by the oil. This is sometimes very difficult to accomplish, however, or requires too much oil, and a shallower penetration must then be accepted. A penetration of from one-half to three-fourths of an inch should give very good results. Even lighter penetrations, though they are not as effective,

will probably give sufficient protection to more than repay the cost and inconvenience of treating. The treatment should extend far enough up the post so that at least 6 inches of treated wood will be above the ground line when the post is set. During the cooling period the absorption of oil by the posts will lower the height of the oil in the tank. Care should, therefore, be taken to see that there is always enough oil in the tank to keep the oil to the proper height on the posts.

The length of time the wood is held in the hot and cold baths should be determined by the penetration obtained and the amount of oil absorbed. The most efficient treatment is the one that gives the greatest penetration with a moderate absorption of oil. The depth of penetration may be determined by boring a small hole in the treated wood at the point where the ground line will be. This hole should be tightly plugged with a creosoted plug before the post is set. The reason for taking the depth of penetration at the ground line is that this is the point at which decay is usually most severe, and therefore the point at which depth of treatment is most important.

Ordinarily it will not be necessary to leave the posts in the hot bath over three hours, and with many woods a much shorter time may give good results. The same is true of the cold bath. If the penetration of oil is not sufficient, either the time of the hot or the cold bath should be lengthened. If the penetration is satisfactory, but too much oil is absorbed, the time of the cold or cooling bath should be shortened. Green or partly seasoned posts or posts wet from recent rains require a much longer time for the hot bath than seasoned, dry posts. The amount of oil absorbed per post[3] will vary with the kind of wood and the size of the post. In general, it should be between four-tenths and six-tenths of a gallon for a post 5 to 6 inches in diameter. The objection to higher absorptions is the greater cost for oil.

During the heating period the temperature of the creosote should be kept as nearly constant as possible, or, still better, it should be allowed to increase very slowly. If it can be avoided, the temperature should not be allowed to fluctuate. Temperatures between 200° and 220° F. are satisfactory. For timber which treats very easily 180° may prove high enough. The temperature should not be allowed to go above 220°, as some of the oil is lost by evaporation at high temperatures. There is also danger that the oil will boil over the sides of the tank if the temperature gets too high. The "cold" bath should be warm enough to thin the oil thoroughly. A temperature of 100° will usually be found sufficient for this purpose.

Various woods differ so in their susceptibility to treatment that a general rule for treating can not be given. In Table 1, however, are shown the results obtained in some experiments with a number of kinds of wood.

[3] In purchasing oil it should be remembered that in addition to the oil absorbed some oil will be left in the tank after the last posts are removed. The quantity will depend on the size of the tank, but will be enough to fill the tank to a depth of about 1½ to 2 feet.

TABLE 1.—*Results secured in the treatment of various woods*

[All posts were round, peeled, and seasoned]

Species	Absorption per 5-inch post	Penetration		Single-tank treatment			Double-tank treatment	
		2 feet from butt	2 feet from top	Butt		Top		
				Hot oil	Cooling oil		Hot oil	Cold oil
	Galls.	*In.*	*In.*	*Hrs.*	*Hrs.*		*H. min.*	*H. min.*
Ash, white	0.4	0.4		5	12	Dipped [1]		
Basswood	.6	.1	0.05				1	30
Bay, sweet	.6	.4	.2				1	30
Beech	.6	1.0	.4				1	45
Birch, river	.6	.7	.3				3	1
Butternut	.4	[2].5		6	12			
Elm, American	.4	[2].4		6	12			
Elm, slippery	.6	[2].3	.1				1 30	1 30
Gum, black	.6	.6	.3				1	1
Gum, red	.6	1.0	.3				1	45
Gum, tupelo	.6	.6	.3				1	1
Hickory, bitternut	.4	.5		6	12	Dipped [1]		
Maple, red	.6	1.0	.3				4	2
Maple, sugar	.6	.2	.1				3	2
Oak, pin	.5	[2]1.0	.5				1	45
Oak, red	.4	[2].5	.3				1	45
Pine, loblolly	.5	1.5	1.0				1 30	1
Pine, lodgepole	.6	1.2	.6				1 30	1
Pine, pitch	.5	1.0	.3				3	1
Pine, Virginia	.5	1.0	.4				3	2
Pine, shortleaf	.5	1.0	.3				3	1
Pine, western yellow [3]	.5	.7					2 30	{ 1 30 2
Poplar, white	.5	.5	.2				6	12
Poplar, yellow	.6	.4	.1				2	30
Sycamore	.6	1.0	.2				1	30
Willow, European white [4]	.6	.6	.2				4	1

[1] Dipped for 5 minutes or more.
[2] Width of sapwood. Penetration limited by impenetrable heart.
[3] Average results from 6,000 posts.
[4] Requires especially thorough seasoning.

It may be noted that most of the posts in Table 1 were given a light top treatment in addition to the butt treatment. This is strongly recommended except in regions where experience has shown that the upper parts of the posts do not decay in service. Top treatment does not seem to be very important throughout the high regions of the Rocky Mountain States, but in experiments with butt-treated posts or poles in many other parts of the country the untreated tops have often rotted while the treated parts remained in good condition.

There are two methods of giving the top a light treatment. In one method the cold tank is made long enough to hold the posts lying full length. In this case when the posts are transferred to the cold tank they are entirely submerged in the oil. This results in a comparatively heavy absorption in the butts, which have been heated, but only a light absorption in the tops. Another method is to complete the butt treatment of the posts first, and then turn them upside down in a tank of hot oil and allow them to remain for a few minutes. The oil should be deep enough in the tank to cover all the post not treated before. If this is not possible, a swab should be used to souse the oil all over the wood not previously submerged. The swab can be made by tying a piece of burlap on a stick. Particular care should be taken to fill all checks and cracks with the oil.

A more thorough method would be to submerge the entire post during both the hot bath and the cold bath. This would make a

more durable post, but the absorption of oil would probably be more than double, and it is doubtful that the additional expense would generally be justified.

Sometimes, in seasoning, the outer surface of the wood becomes hard and has a glazed appearance. This effect is called "casehardening," and it may seriously retard penetration by the oil. Before treatment, such a hardened surface should be shaved off with a drawshave for about 8 inches above and 12 to 15 inches below the ground line. The rest of the butt need not be shaved.

After treatment it is a good plan to stand the posts upside down. This allows any excess oil in the butts to flow toward the top and stay in the wood, instead of dripping on the ground. They should not be left in this position more than a few weeks, especially if the tops are untreated, as decay may start in the part which touches the ground.

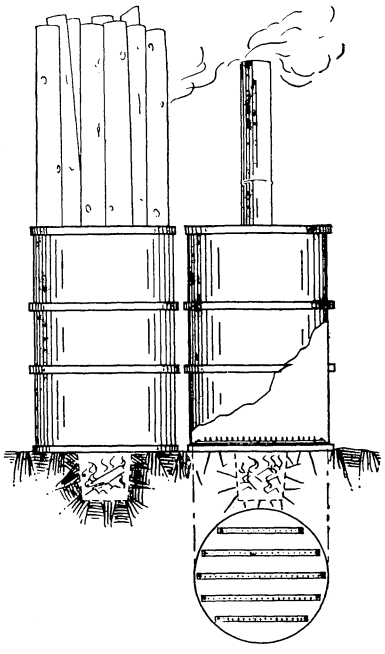

FIG. 13.—Treating plant made from two oil drums, showing method of constructing false bottom

APPARATUS FOR HOT AND COLD BATH TREATING

The essential parts of the apparatus for general farm use are one or two tanks (depending on whether the hot and cold or hot and cooling method is used), a thermometer, and some means of heating.

The chief requirements of the tanks are: (1) That they shall be strong enough to hold the weight of the oil and the posts; (2) that they shall not leak; (3) that they shall be deep enough, so that the surface of the oil will be a foot or more below the top of the tank during treatment; and (4) that they may be readily heated. Any metal tank of convenient size which will satisfy these requirements will do. Wooden tanks or barrels will not do unless lined with metal, because they leak too much when oil is heated in them. The heating may be accomplished by a fire beneath the tank or by means of steam coils. If an open fire is used, care should be taken to prevent the oil from slopping over the side of the tank and taking fire. This is the reason for having the surface of the oil a foot below the top of the tank. Though the oil is not dangerously inflammable, and ordinary care will prevent trouble, carelessness may result in the loss of the oil and the posts. The treatment should be made, of course, in a situation where an accidental fire will not endanger any buildings, crops, or other valuable property.

In Figure 13 is shown a plant made from 110-gallon oil drums by cutting out one head of each drum. A 50-gallon drum is not suitable because it is too short. In order to keep the posts from floating in

the oil, it is well in a plant of this kind to use a false bottom in each drum, such as is shown in the illustration. This can readily be made out of the heads cut from the drums, or any flat piece of iron, by riveting on strips of iron through which several screws protrude from one-half to three-fourths of an inch. The screws stick into the posts and keep them from moving about and floating in the oil.

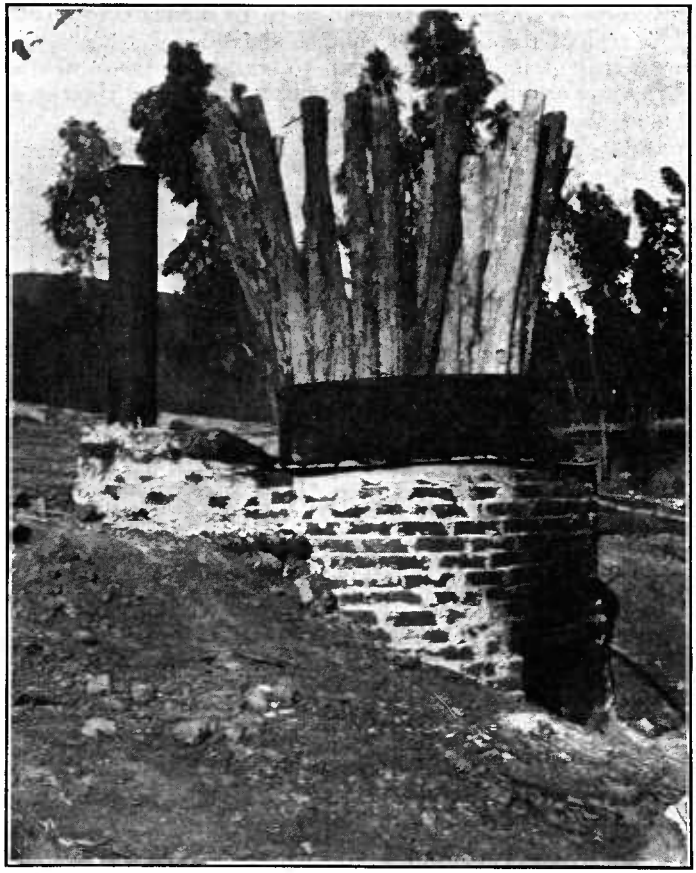

FIG. 14.—Heavy iron tank with brick fire box

Figure 14 shows a more permanent type of plant, in which the tank is made of comparatively heavy metal and is surrounded by a brick fire box.

Figure 15 shows a plant built for treating the entire post, giving a heavy butt treatment and a light top treatment. The horizontal tank is 8 feet long, 3 feet wide, and 3 feet deep; the round tank, about 3 feet in diameter and 4 feet deep. The pole and stand shown are for use with the mortised board shown in the rear, to hold the posts under the oil during the cold bath.

In Figure 16 the details of construction of the tanks used in one experimental plant are shown. This was a portable plant heated by

steam from the boiler of a threshing engine. Between the steam pipes in the bottom of the tanks strips of 2-inch lumber studded with screws were placed and firmly wired to the pipes. The points of the screws projected about three-fourths of an inch above the wood and served to keep the posts from sliding about. Without the screws it would have been impossible to put a full charge of posts into the tank. On both sides of each tank, about 18 inches from the top, 2 by 12 inch planks were suspended by means of ⌐⌐-shaped irons which hooked over the sides of the tanks. This made a very satisfactory working platform. Since the tanks were made of rather thin sheet metal, they were strengthened by surrounding them with crates or frames of 2-inch lumber. The capacity of the tanks was from 40 to 105 posts per charge, depending on the size

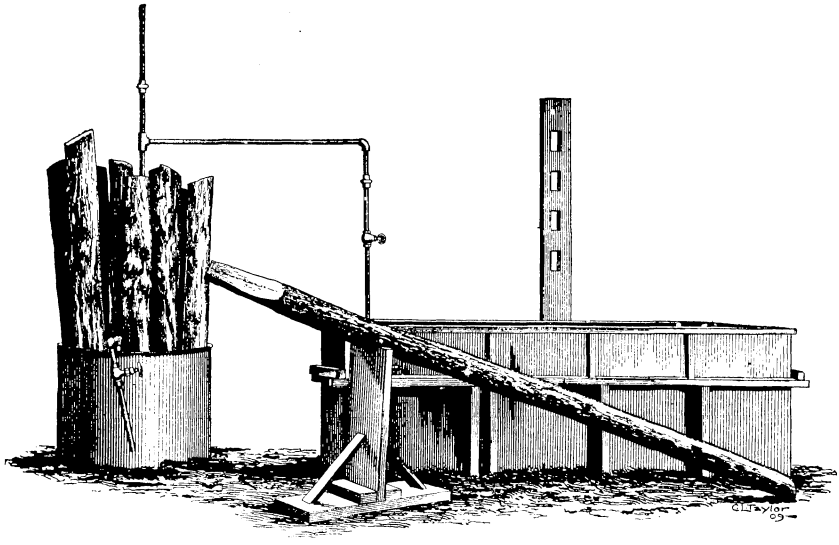

FIG. 15.—Experimental outfit heated by steam. The rectangular horizontal tank is for the cold bath

and shape of the posts. The total cost of the tanks (pre-war prices) was about $280.

Figures 13 to 16 show only a few varieties of treating outfits that might be employed. Secondhand tanks of various kinds which will be entirely satisfactory may often be bought very cheaply. A good tank can be made by welding a bottom into a piece of large corrugated-iron culvert pipe and making the side seam tight. Tanks of sheet metal too thin to stand rough usage can be strengthened by boxing them in with suitable frames.

The number of posts to be treated should determine the character of the plant used. If only a few posts are to be treated, a simple plant similar to that shown in Figure 13 is most suitable. For a large number of posts or timbers of other kinds, more elaborate apparatus is advisable, such as that shown in Figure 16, or perhaps a stationary plant with steam boiler, storage tanks, oil pumps, a derrick for lifting the timber, and other equipment. In any kind

of a plant the operator must provide platforms and other means of handling the posts to the best advantage.

It may prove of advantage sometimes for a number of farmers to cooperate in the erection of a permanent plant of this kind or

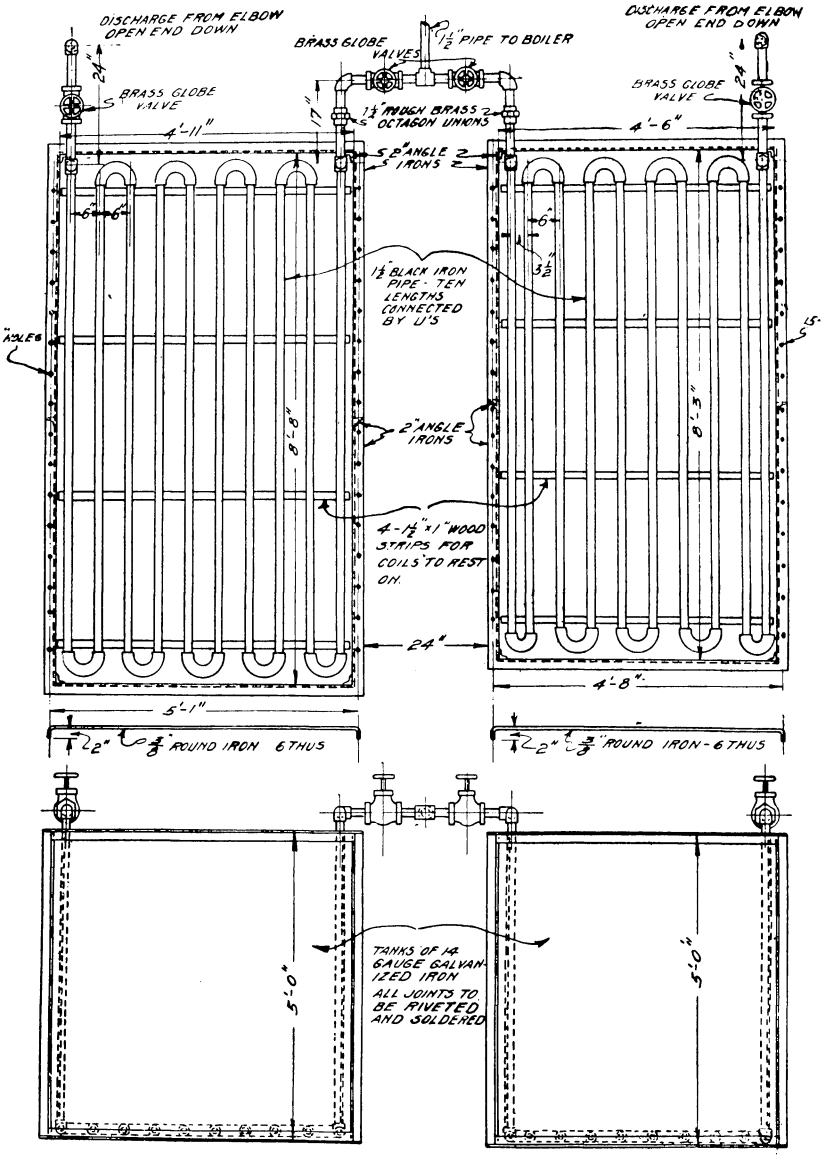

FIG. 16.—Details of construction of tanks for portable plant

a portable plant, such as that shown in Figure 16. Such a plant could either be loaned to each of the cooperators in turn to treat his own timber or it could be placed in charge of an operating crew of two or three men who would make all the treatments.

HOT AND COLD BATH TREATMENT WITH WATER SOLUTIONS

Although the hot and cold bath method is especially suitable for oils, it may, with proper precautions, also be used with preservatives such as zinc chloride and sodium fluoride which are dissolved in water. The apparatus and the general method of treating are the same, whether oils or water solutions are used. The chief difference is that with water solutions the strength of the solutions must be watched and corrected from time to time by the addition of water or chemical. This so complicates the treating that anyone not familiar with the use of hydrometers will find the use of oils more convenient and simple. A solution strength of about 5 per cent is recommended for zinc chloride. For sodium fluoride a 3½ per cent solution is recommended, since this chemical is not soluble enough to make much stronger solutions. With either the zinc chloride or the sodium fluoride the wood should be made to absorb all the solution it can.

THE DIPPING PROCESS

The dipping process is considered suitable only for preservatives of an oily nature. The wood is simply heated in oil at from 200 to to 220° F. for from 5 to 15 minutes or longer. This allows all checks and defects to become filled with oil, but the penetration and absorption of oil are usually slight. On account of the small amount of oil used and the large number of posts that can be treated in a day, it is much cheaper than hot and cold bath treatment, but it is also much less effective. Under no circumstances should any but thoroughly peeled, well-seasoned timber be used. Unseasoned wood, or that which is wet with snow or rain, is not suitable because the oil will not penetrate it readily. In very cold weather a longer time in the hot oil will be required to get the wood warm. The treatment should extend at least 6 inches above the ground line.

The apparatus for dipping consists of a tank, a thermometer, and some means of heating. Generally, it will be advisable to use a comparatively small tank in order that there will not be a large amount of oil left over after the last posts have been treated.

THE STEEPING PROCESS

The steeping process is used with water solutions only. It consists in simply soaking the well-seasoned wood for a week or more in a tank of unheated preservative solution. If the time is very limited the wood may be removed after two or three days, but soaking periods of one week or even two weeks are better. The wood should be kept submerged during the whole period and the tank should be covered, if possible, to keep out rain and to reduce evaporation. For zinc chloride 5 per cent and for sodium fluoride 3½ per cent solutions are recommended.

Detailed instructions for preparing solutions and treating by the steeping process may be obtained from the Forest Products Laboratory.

BRUSH TREATMENT WITH CREOSOTE

Brush treatment or painting is considered suitable for creosote or carbolineums only and consists in applying two coats of the preservative to the wood. The oil should be heated to from 200° to 220° F. and flooded over the wood rather than painted upon it. If the

preservative is thoroughly liquid it may be used without heating, but it is better when hot. Especial care should be taken to fill every check and defect in the wood, and the first coat should be allowed to dry completely before the second coat is applied. The advantage of the painting method over the others is the small amount of preservative it requires and its cheapness and simplicity. No excess of preservative need be left over after the last post is treated. It is also of value in treating portions of large sticks which can not readily be tank treated and in treating timber at joints and all points of contact where decay is liable to occur. Its disadvantage is that it usually adds less to the durability than dipping, hot and cold bath, or pressure treatment.

Like dipping, the painting method is most suitable for use on peeled, thoroughly seasoned, and dry timber. It is best to use it in warm weather; for in cold weather, when the hot cresote touches the cold wood, it immediately cools and does not penetrate readily.

The apparatus for brush treatment consists of a large kettle or pail of some kind to heat the oil in, a smaller pail to paint from, and a wire-bound, long-handled paintbrush. A small soft broom might be substituted for the paintbrush if desired. If a thermometer is available, it can be used to advantage. If none can be had, the oil should be heated very hot but not to boiling. Care should be exercised to prevent the oil from boiling over and taking fire.

Ordinarily the oil is heated over an open fire, but where a large amount of work is to be done, or the work is widely distributed, it may be found advantageous to use a special oil heater, such as is shown in Figure 17. The heat is supplied by a gasoline blowtorch and a thermometer is used to regulate the temperature. The pail is made detachable so that one or more can be in use while another is heating. The construction of the heater is simple, and it can be made by any competent tinner.

CARE OF TIMBER AFTER TREATMENT

The effectiveness of any of the methods of treatment which have been described is dependent upon keeping an unbroken layer of treated wood over the entire treated surface.

Care should be exercised in handling treated timber so that the treated wood is not scraped away or otherwise injured and untreated wood thereby exposed.

Treated timber should never be cut if it can be avoided. All sawing and framing should be done, if possible, before treatment. If it is necessary to saw after treatment, the exposed untreated wood should be painted with several coats of hot creosote before it is put in place.

If butt-treated posts or other timbers of which only a part is treated are not to be used for some time, they should be open piled after treatment. If they are close-piled or allowed to lie on the ground for a considerable length of time, decay is likely to start in the untreated parts. If the timber is treated all over, it should be close-piled, but the pile should be raised off the ground.

In setting treated posts, poles, and other timbers great care should be used to avoid setting them too deep. At least 6 inches of treated wood, and more, if convenient, should extend above the ground after the posts are set. Where this precaution has not been observed the posts have sometimes decayed above the treated part.

ADAPTABILITY TO TREATMENT

As is shown in Table 1, some species of wood are much easier to treat than others; and whenever there is a choice between several species this fact should be taken into consideration.

In general, the pines are very easy to treat. Other woods which have been found to treat very readily in the form of round posts are beech, river birch, the gums, pin oak, red oak, and sycamore. Many other species, however, can be successfully treated; and, in fact, almost any kind of nondurable wood can be improved by proper

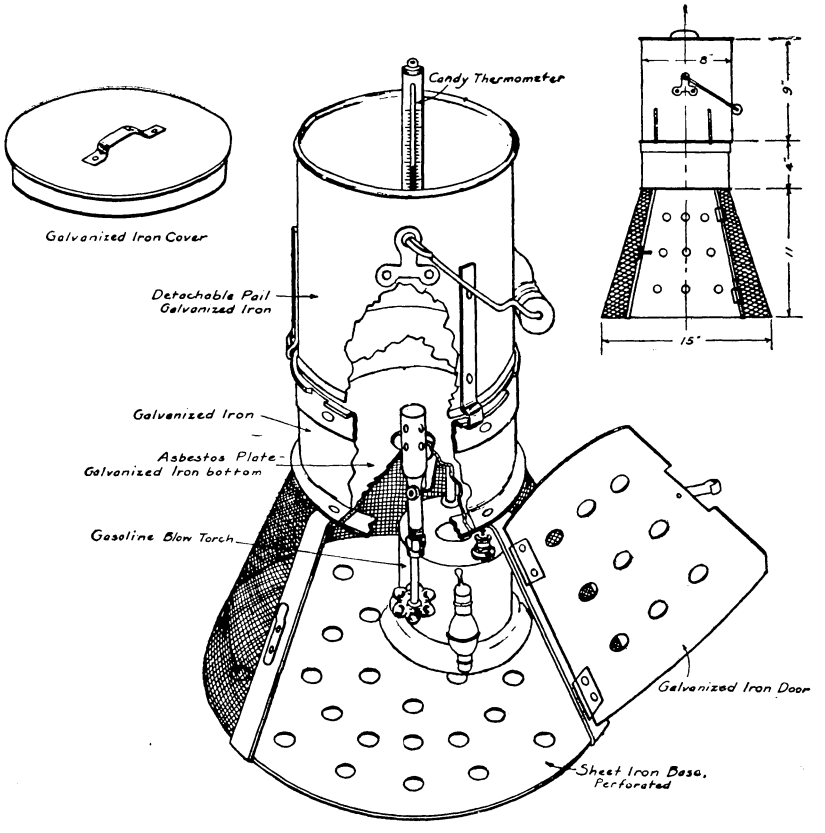

FIG. 17.—Creosote heater for brush treating

treatment. Treatment will also greatly improve many of the species having durable heartwood and nondurable sapwood.

In most woods the sapwood treats much more easily than the heartwood. In very few species can a satisfactory penetration be obtained in the heartwood by the hot and cold bath process. In general, therefore, a more uniform and satisfactory treatment can be obtained in round posts, of which the entire outer surface is sapwood, than in split or sawed posts, in which heartwood is necessarily exposed. Among the exceptions to this rule are eastern hemlock, in which the sapwood is as difficult to penetrate as the heartwood, and sycamore, in which the heartwood is readily treated.

In some localities there are considerable amounts of standing dead timber which has been killed by fire, insects, or some tree disease, and which is still sound. For the most part this timber can be successfully treated. Such timber, if it is entirely free from decay and not seriously injured by wood borers, is practically as good as live timber and is well adapted to treatment because already more or less seasoned. It makes good material for posts, poles, and many other of the common forms in which wood is used. Blight-killed chestnut and fire and insect-killed lodgepole pine are in this class.

COST OF HOT AND COLD BATH TREATMENT

As a rule, the principal item of cost in the treatment of timber is the preservative. The price of coal-tar creosote varies. Near the manufacturing plants it can usually be obtained at from 25 to 60 cents per gallon in small lots. In other localities the freight will make the price somewhat higher. In tank-car lots the price ranges from about 20 to 40 cents per gallon. It may prove feasible in some cases for a number of farmers to cooperate in buying creosote in order to obtain the reduction in price due to purchasing in large quantities. The exact cost in any case will have to be determined by inquiring of the dealer from whom the oil is to be obtained. A list of dealers may be obtained from the Forest Products Laboratory or from State authorities.

The cost of applying the preservative depends mainly upon the number of posts to be treated, the cost of apparatus, labor, and fuel, and the number of posts which can be treated per day. The number of posts treated per day will, of course, vary according to their size and ease of treatment. The cost of treatment will vary greatly in different localities and in accordance with differing local conditions, so that a general cost figure can not be given. In Table 2, however, are given some figures obtained in the open-tank treatment of posts in several localities. The cost of oil may vary widely from the figures given in the table. The cost of the apparatus is not included in the calculations.

TABLE 2.—*Cost of treatment under certain conditions*

Locality	Kind of post	Cost of oil		Cost of treating per post	Total cost of treatment per post	Remarks
		Per gallon	Per post			
Louisiana	Loblolly pine	$0.15	$0.09	$0.01	$0.10	Entire post impregnated, cost of labor not included.
Maryland	Virginia pine	.15	.09	.01	.10	Do.
Maine	Aspen	.12	.06	.01	.07	Butt impregnated, top dipped, cost of labor not included.
Minnesota	Cottonwood	.12	.06	.01	.07	Do.
California	Western yellow pine	.24	.12	.07	.19	Butt impregnated, cost of labor included at $2.50 per day.
Montana	Lodgepole pine	.18	.12	.14	.26	Heavy butt treatment and lighter top treatment, with a creosote-petroleum mixture, cost of labor included.
Do	Cottonwood	.18	.41	.14	.55	Heavy butt treatment and lighter top treatment, with a creosote-petroleum mixture, cost of labor included. High cost due to high absorption of oil.
Do	Western red cedar	.18	.06	.05	.11	Butt treatment only, with a creosote-petroleum mixture, cost of labor included.

VALUE OF TREATMENT

Unless a reasonable saving can be effected by preservative treatment of wood, the expense involved is not justified. The saving due to preservative treatment will depend upon local conditions. In some localities durable posts are expensive and difficult to obtain, whereas nondurable, easily treated woods are abundant and cheap. It is in such localities that treatment is particularly desirable. In other localities there may be a plentiful supply of durable timber which can be obtained very cheaply. In such places it may not be advisable to attempt preservative treatment.

The chief points which must be considered in determining whether treatment will pay are the original cost and the average life of untreated and treated posts, or, in other words, the cost per year of service. The cost and approximate life of untreated posts of the different woods in common use in any locality will generally be known to the residents of that locality. It is estimated that a thorough hot and cold bath treatment of fence posts, for example, a heavy butt treatment and a light top treatment, will give to nondurable woods an average life of at least 20 years. This estimate is based on the best information obtainable on the durability of well-creosoted posts and other creosoted timber. It can not be considered as conclusive, however.

In estimating the cost of an open-tank treated post the chief items to be considered are the original cost of the post and the cost of the oil absorbed. In general, from four-tenths to six-tenths of a gallon of creosote will be required per post. In order to get a close estimate of the cost per year of service, the cost of setting the post should be included in the calculations. Interests on the money invested may also be included. If desired, the costs may be figured on the basis of cash outlay only, leaving out all items which do not require the actual expenditure of money. This method, however, does not give a true comparison of the relative economy.

If it is found in a certain locality that cedar posts which will last 12 years can be obtained for 30 cents and that treated pine which will last 20 years can be obtained for the same price, money will be saved by using the treated pine; or, if a locust post can be obtained for 50 cents and a treated beech post which will probably last about as long costs half as much, it will be economical to treat the beech. On the other hand, if an untreated post which will last 12 years can be obtained for 10 cents and a treated post which may be expected to last 20 years costs 50 cents, it will not be economy to treat.

SERVICE TESTS OF TREATED POSTS

To obtain more exact information about the average life of treated posts under various conditions experimental posts are being tested in fences in many parts of the country and careful records of their durability are being kept. In Table 3 are given the results so far obtained in a number of these experiments.

TABLE 3.—*Results obtained in experiments on durability of posts, 1908–1927*

Location	Kind of posts	Extent of treatment	Date set	Date of last inspection	Service at last inspection	In test	Removed up to last inspection		Remarks
					Years	*Number*	*Number*	*Per cent*	
A. Creosoted posts (open-tank process)									
Ames, Iowa	Ash [1]	Butts only	Spring and fall, 1909	Nov 1926	17	22	19	86.4	
Do	Northern white cedar.	do	Spring, 1909 and 1910	do	16 to 17	448	5	1.1	
Do	Willow [1]	do	Fall, 1909	do	17	37	26	70.3	
Zumbra Heights, Minn	Basswood	Entire post	1908 to 1909	Oct., 1926	17 to 18	298	67	22.5	
Do	Cottonwood	do	do	do	17 to 18	33	7	21.2	
Do	Sugar maple	do	do	do	17 to 18	21	2	9.5	
Do	Red oak	Butts only	do	do	17 to 18	86	8	9.3	48 red oak posts given butt treatment only have tops badly decayed and warrant early removal.
Do	do	Entire post	do	do	17 to 18	287	21	7.3	
Calhoun, La	Sweet bay	do	1908 to 1910	Jan., 1925	15 to 17	126	73	57.8	After treatment posts were stored in pile for various periods up to 2½ years.
Do	Southern cypress	do	do	do	15 to 17	69	9	13.0	
Do	Black gum	do	do	do	15 to 17	59	15	25.4	
Do	Red gum	do	do	do	15 to 17	161	52	32.3	
Do	Tupelo gum	do	do	do	15 to 17	77	27	35.1	
Do	Loblolly pine	do	do	do	15 to 17	375	194	51.7	
College Park, Md	Beech	do	1908	June, 1927	19	21	1	4.8	
Do	River birch	do	do	do	19	16	5	31.2	
Do	Black gum	do	do	do	19	26	None.		
Do	Chestnut	do	do	do	19	21	3	14.3	
Do	Black locust	do	do	do	19	22	1	4.5	
Do	Red maple	do	do	do	19	18	2	11.1	
Do	Pin oak	do	do	do	19	14	None.		
Do	Eastern red cedar	do	do	do	19	25	None.		
Do	Red oak	do	do	do	19	15	1	6.7	
Do	Virginia pine	do	do	do	19	42	None.		
Do	White poplar	do	do	do	19	14	5	35.7	
Do	Red gum	do	do	do	19	22	None.		
Do	Sycamore	do	do	do	19	19	None.		
Do	White oak	do	do	do	19	33	None.		
Do	Willow, black and European white.	do	do	do	19	48	12	25.0	
Do	Yellow poplar	do	do	do	19	35	None.		
Dillon, Colo	Lodgepole pine	Butts only	Fall, 1908	do	18½	534	22	4.1	
Do	do	do	do	do	18½	99	4	4.0	
Missoula, Mont	do	do	Fall, 1916	Oct., 1926	10	45	None.		

B. Untreated posts	Flagstaff, Ariz.	Aspen		October, 1910	July, 1920	10	20	10	50.0	6 posts badly decayed and warrant early removal.
	Do.	Juniper[1]		do	do	10	20	None.		
	Do.	Western yellow pine.		do	do	10	59	38	64.4	8 posts badly decayed and warrant early removal.
	Missoula, Mont.	Western red cedar.		Fall, 1916	Oct., 1926	10	51	None.		
	Waterbury, Conn.	Chestnut		April and May, 1913	June, 1927	14	345	40	11.6	
	Beaver Ranger Station, Oreg.	Douglas fir		May, 1914	Apr., 1925	11	17	12	70.6	
	Do.	Western larch		do	do	11	60	44	73.4	
	College Park, Md.	Black locust		1908	June, 1927	19	20	None.		
	Oregon, Wis.	White oak		1913	Oct., 1927	14½	437	320	73.2	
	Fort Collins, Colo.	Lodgepole pine		1912	1924	12	20	15	75.0	
	Do.	Engelmann spruce		do	do	12	20	17	85.0	

[1] Exact species not recorded.

PROLONGING THE LIFE OF OTHER FORMS OF FARM TIMBERS

There are many forms of timber used on the farm to which treatment can be advantageously applied. Among these are silos, rural telephone poles, shingles, sills, foundation timbers, bridge timbers, board walks, wooden gates, windmill frames, porch columns, and well curbing. The treatment of any nondurable wood which is used where conditions are favorable to decay is worthy of careful consideration.

SILOS

A thorough treatment with coal-tar creosote will make a wooden silo more resistant to decay and less subject to shrinking and swelling. It will also make painting unnecessary.

The most satisfactory way to inject creosote into silo staves is by impregnation under pressure. It may sometimes be possible for a farmer to haul his untreated silo lumber to a creosoting plant and have it treated, but pressure treatments will usually have to be made by the manufacturer before the silo is sold. Some manufacturers are already doing this, and it is now possible to purchase a pressure-treated silo all ready to set up.

Next to pressure treatment, open-tank treatment is best; but on account of the length of the staves and the long, narrow tank required it may be inconvenient to use this method. A good combination treatment would be to give the lower 2 or 3 feet of each stave an open-tank treatment and the remainder a 2-coat brush treatment. If this is done, the part of the staves most subject to decay will receive the heaviest treatment. All the wood which touches the foundation should be thoroughly treated. As with any treated timber, no sawing or cutting that can be avoided should be done after the wood is treated. All untreated surfaces necessarily exposed by cutting should be heavily painted with the preservative.

Brush and dipping treatments are less efficient than hot and cold bath or pressure treatments and will not give as great an increase in durability. They may be used to advantage, however, when the better methods are entirely out of the question.

One possible objection to the use of creosoted lumber in silos is that the silage might be contaminated by creosote bleeding from the wood. Information obtained by the Forest Service, however, indicates that there is little danger of this if proper care is used. In order to prevent contamination, the treated wood should be thoroughly air seasoned in open piles after it is treated and before it is put into the silo. In hot and cold bath or pressure treatments the absorption of oil should not exceed 8 or 10 pounds per cubic foot of wood.

Of the woods in general use for silo construction the pines are, as a class, the most easily treated; the hemlocks, western larch, the spruces, and Douglas fir are somewhat more difficult. With pressure treatment the greatest saving can usually be effected by using the cheaper woods, as the differences in the durability of the various species is less after treatment than before. It is questionable if the treatment of such durable species as heart redwood and heart cypress would pay.

SHINGLES

The application of paint is the preservative measure most commonly used for shingles; and if the paint is properly applied it will add to their durability by protecting them from the weather, reducing moisture changes, and preventing cupping. If it is not properly applied, however, it may even hasten decay. For preservative purposes the best way to apply the paint is by dipping the shingles in it. This may be found impracticable, however, since the amount of paint which would adhere to the shingle would in many cases be too great unless some means were provided to brush off the excess.

When the shingles are painted after the roof is laid, a ridge of paint is liable to form at the base of each shingle. This tends to hold the water after a rain and keep the shingles moist, thus making conditions more favorable to decay.

Brush treatment with creosote or a good shingle stain does not leave a ridge like ordinary paint and can be recommended as good practice, but dipping the shingles in the preservative is better in this case also. The best results in preventing decay are obtained, however, by first heating and then cooling the wood in creosote as described for the treatment of fence posts.

The hot and cold bath process has already been explained. The apparatus used for posts may be employed; or if shingles exclusively are to be treated, the form of the outfit may be modified. The simplest apparatus is a single tank large enough to hold a bundle of shingles. If a larger capacity is desired, the depth rather than the width should be increased; for, in order to minimize the loss of oil by evaporation, the oil surface exposed to the air should be kept as small as possible. The best treatment for various kinds of shingles has not yet been determined. The most desirable treatment is the one which gives the best penetration with the least absorption of oil. Sap-pine shingles, thoroughly seasoned, can be completely penetrated without difficulty, but cedar shingles are more difficult to treat. The proper treatment in any case must be determined by observing the absorption of oil and the penetration secured and varying the treatment accordingly. The oil should not be allowed to get too hot, however, or the shingles held in it for too long a time; for in either of these events the shingles may become somewhat brittle.

A very satisfactory treatment was obtained in western red cedar shingles by heating them in creosote for 2 hours at 210° F. and then allowing them to cool for 1 hour, during which time the temperature of the creosote dropped to 176° F. The absorption was about 20 pounds or 2.3 gallons of creosote per bundle. In another satisfactory treatment a 2-hour bath at 210° followed by cooling 2 hours to 165° resulted in an absorption of about 27.5 pounds or 3.1 gallons of creosote per bundle. This treatment saturated the sapwood and penetrated the heartwood about one-sixteenth of an inch. Either treatment should give the shingles a very long life.

While creosote treatment can be expected to increase very materially the resistance of shingles to decay, the treated shingles possess certain objectionable qualities which should be kept in mind when considering their use; for instance, their strong odor and their contamination of cistern water. Further, since the shingle nails some-

times become covered with creosote and can not be held in the workman's mouth, it is more inconvenient to lay these shingles. The odor, however, disappears in the course of a few weeks—two weeks in one case observed. The contamination of the cistern water may be of longer duration, though in one instance the water was tasteless after three days of rain. All these objections may be lessened if the shingles are seasoned for a few weeks between treating and laying.

It is held by some that creosote treatment makes shingles more inflammable and thus increases the fire danger, and it seems probable that this is true of freshly treated shingles. After a few months on the roof, however, it is doubtful if there is much difference in the inflammability of treated and untreated shingles.

TELEPHONE POLES

When farmers' cooperative telephone lines are constructed, the treatment of the poles will frequently effect a saving in the cost of upkeep. The hot and cold bath treatment will, of course, give a much longer life than brush treatment; but the cost of the tanks, the extra oil required, apparatus for handling the poles, and the extra labor may not be justified unless a large number are to be treated. Brush treatment will, therefore, in many cases be the most practicable method to use. In most parts of the United States a butt treatment is sufficient to protect poles of the common durable pole species; but in the warm, moist climate of the Southern States it is desirable to treat the entire pole, especially if sap pine or other nondurable woods are used.

In the repair of pole lines, where the poles are decayed near the ground and sound above the ground, it is often economical to place a creosoted stub beside the old pole and fasten the two firmly together with wire or bolts. (Fig. 18.) Stubbing will not pay, however, unless there is enough service left in the upper parts of the old poles to justify the expense.

The tops of the poles and the gains cut in the poles to hold the cross arms should be brush treated. Pole braces should be treated like the poles. Wherever a pole brace touches a pole, both should be brush treated at the point of contact.

BRIDGE TIMBERS

Treatment of the timbers and planks of permanent farm or highway bridges will add materially to their resistance to decay. Hot and cold bath and pressure treatments are the best. Brush or dipping treatments of the face of the planks would soon be worn away and would be of little value; but they may be used to advantage in other parts of the structure.

SILLS AND FOUNDATION TIMBERS

Sills and foundation timbers in contact with the ground or with stone or concrete foundations frequently decay rapidly, and preservative treatment is advisable. It is probable that brush treatment will usually be found the only convenient way to treat such timbers on account of their size, but wherever possible better treatments should be used.

JOINTS AND POINTS OF CONTACT

Experience has shown that in any timber structure where the wood comes in contact with wood, stone, or other material, decay is liable to occur more rapidly at the point of contact than in other parts of the structure. (Figs. 5 and 6.) If it is impracticable to treat the timber for the whole structure, it will frequently be profitable to give a good brush treatment to the joints and other points where decay is usually most severe.

FIG. 18.—Decaying pole reinforced with a creosoted stub. Many years' additional service may thus be obtained

CARE OF LUMBER, TIMBER, AND POLES

It is important in the case of poles, lumber, and timbers of all sorts to season the wood properly before treatment, to pile it so it will not decay during seasoning, and to care for it properly after treatment. In general, the precautions given for fence posts will apply, but the piling methods will vary somewhat according to the character of the material. All sawed lumber and timber during seasoning should be piled upon skids or sills at least a foot above the ground. The layers of boards or timbers should be separated by narrow stickers or crossers about 1 inch thick. The stickers should be lined up vertically over the skid timbers, and they should be spaced closely enough along the length of the pile to prevent the bending of the boards. The piles should be sloped lengthwise, so that rain water can run off quickly. Silo lumber after treatment should be piled as for seasoning. Other lumber, which has been treated all over, should be kept in solid piles until used.

COOPERATION

When several people in a community treat wood cooperatively the cost of treatment can often be reduced because the price of creosote is less per gallon when purchased in large quantities. If enough people cooperate, a large and convenient plant can be constructed and kept in operation at a central location at a low cost per man. This is especially desirable where the creosote and the wood to be treated are shipped into the community through some central point. Where

posts or poles are cut on widely separated farms it may be better to purchase a smaller plant, which can be moved easily from farm to farm.

LOCAL ASSISTANCE

The agricultural experiment stations, forest schools, and other agencies in several States have issued bulletins on creosoting fence posts. Some of them are prepared to give very helpful advice on the kind of plant to use, where to buy preservative cheaply, and how to do the work. They, as well as county agents in some localities, can also be helpful in working up good cooperative projects, and when available such assistance should be sought.

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